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REVIEW ARTICLE

The unanswered question. By LEONARD BERNSTEIN. Cambridge, MA: Harvard
University Press, 1976. Pp. x, 428; with three 7-inch phonodiscs. $20.00.

Reviewed by RAY JACKENDOFF, *Brandeis University**

This book is the written version of the Charles Eliot Norton Lectures, given by
Bernstein at Harvard in the fall of 1973. In addition to this version, videotapes of
the lectures have been broadcast nationally, and Columbia Records has issued an
eighteen-disc recording of them.

The book, a lightly edited transcript of the lectures, is lavishly produced, with
numerous musical examples illustrating the text, and with many photographs of B
at the videotapings. For those musical illustrations too complex for the reader to
figure out on his own piano, three seven-inch LP discs are provided, each band of
which is keyed into the appropriate point in the text. In short, the book attempts to
convey to the reader the experience of attending the lectures. The main elements
missing are the videotapes of B conducting the Boston Symphony in works
discussed in the lectures.

1. LINGUISTICS AND MUSIC THEORY. The relevance of this book to the readers of
LANGUAGE is that it is the most highly publicized attempt to date to bring the
methodology of transformational generative grammar to the study of music. B
correctly disregards the pseudo-issue of whether music is a language; unlike many
earlier workers who have tried to bring the disciplines together, he seeks to describe
music in its own terms, using concepts from linguistics only insofar as they are useful
to him.

B's approach is further distinguished from previous ones by the fact that he is not
simply trying to develop rules to generate pieces. Rather, he focuses on a more
appropriate place to look for commonality: the question of musical universals.
Language is a human activity of great complexity, the study of which can (one hopes)
lead to a better understanding of the nature of the organism. B recognizes that
exactly the same is true of music, and in these lectures he attempts to provide an
overview of a possible new discipline: an empirical theory of musical intuitions,
modeled after linguistic theory.

The musically or linguistically sophisticated reader must bear in mind that B is
not a scholar. He has little time or inclination to follow through his concept of
music theory with any thoroughness or systematicity, and he consciously aims to
appeal to a mass audience educated neither in music nor in linguistics. If one
accepts B's terms, one can appreciate the book as a rich mélange of brilliant and
wild theoretical speculations, illuminating descriptions of a variety of musical

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phenomena, and just plain personality—a multi-media, multi-disciplinary happen-ing.

On the other hand, a reader who expects serious intellectual inquiry will un-doubtedly be disappointed. It is a trivial, boring, and sometimes even embarrassing exercise to find holes in B's argumentation. The final effect is unfortunate: B has great insight into the essential issues, yet he undermines himself needlessly in ineffectual attempts to make his speculations explicit. Rather than enumerating criticisms of dozens of specific points—which any reader can surely do for himself—I would prefer to concentrate on some issues which I think are central to B's enterprise.

The most important of these is, as mentioned above, the idea that music can be approached in the way we are accustomed to approaching language. B professes to have become interested in linguistics precisely because of his desire to explain the existence of musical universals. For, as he points out, Chomsky's argument that linguistic universals are a product of highly specific innate human cognitive abilities suggests a parallel hypothesis about musical universals. If we develop the parallelism somewhat more explicitly than B does, something like the following concept of a theory of music emerges.

The goal of a theory of music can be taken to be a formal description of the musical intuitions of an educated listener. By 'musical intuitions' I mean the largely unconscious knowledge which a listener brings to music and which allows him to organize musical sounds into coherent patterns. By 'educated listener' I mean not necessarily a trained musician, but a listener who is aurally familiar with the type or style of music being described. Such a listener is able to identify a previously unknown piece as an example of the style, to recognize its elements as anomalous or unusual within the style—and, generally, to comprehend a piece within the style.

The 'educated listener', even more than the 'native speaker of a language', is of course an idealization. Rarely do two people hear the same piece in precisely the same way or with the same degree of richness. Nonetheless, while it is conceivably possible to hear a piece in any way one wants to, there is usually substantial agreement on what are the most natural ways to hear it, and the theory should reflect this.

In turn, a theory of a particular type or style of music is ideally a subset of a theory of all music. The connection between descriptions of particular styles and a general theory of music is in the study of musical universals, which one can hope to ascribe to innate capabilities in the human mind. The more one can use universals of music to explain the complexities of a particular style, the easier it is to under-stand how people can comprehend that style.

Beyond the search for musical universals lurks another question: after establishing the value of musical and linguistic universals independently, one might justifiably ask whether any interesting generalizations underlie both domains. Such generalizations would reveal still deeper insights into human cognition.

B correctly perceives that, in order to construct a theory of music, one should be seriously concerned with musical universals, even when attempting only to describe a single style. But he seems not to distinguish the question of musical universals

from the question of parallelism between musical and linguistic universals. This confusion inevitably leads him to the dubious strategy of searching for musical universals by drawing analogies with linguistics. This gets him into deep and irrelevant trouble, for although his general concept of linguistic theory is good, he is insecure on specifics—and most of his analogies, as he admits, don't work very well anyway. Since he seems to equate this search for analogies with the search for musical universals per se, the reader may be left with the impression that the whole undertaking is useless.

2. TONALITY. If this misunderstanding is removed, and if one looks in music itself for possible universals, the arguments are far more interesting. The universal with which B is most deeply concerned is, in fact, one which has no linguistic analog at all: tonality, or the existence of tonal centers in music. The role of tonality in Western art music emerges as the primary theme of the book. Practically all musical idioms of the world in which precise pitch plays any role at all (i.e. all except drum music) appear to involve some organizing element that can be called a tonal center. This does not mean that all idioms necessarily have harmonically defined KEYS in the sense of classical Western tonal music—indeed, most musical idioms of the world do not. Rather, it means that, among the pitches that constitute an idiom's scale, there is one pitch that is treated as a point of stability or rest; in many idioms, this is the pitch on which all pieces end.

There is one prominent exception to the claim of the universality of tonality: Western art music of this century, so-called atonal music. And the 'unanswered question' which B poses is 'How did music arrive at this state and where is it going?' To understand the significance of this question, let me briefly summarize B's lengthy and illuminating discussion of atonality and its development. In atonal music, dissonance—formerly used as a creator of tension, as something that required resolution into consonance—has been freed from its classical role. B describes the way this change came about: over the course of the 19th century, the incessant search for new, unhackneyed, and daring harmonic vocabulary led to greater and greater tonal ambiguity. The classical resolution of dissonance became something only indirectly alluded to, thwarted, or delayed. Eventually, as the classical harmonic functions were buried more and more under ambiguous chromaticism, composers seemed to find that the ear no longer used them as a reference point. Other principles of organization seemed to be required, in which the contrast between consonance and dissonance no longer played the same essential functional role. The change in some ways resembles a radical restructuring in the history of a language.

Stravinsky, in his 1939–40 Norton Lectures at Harvard, described his attitude toward tonality like this (1956:37–38):

> '[Dissonance] is no longer tied down to its former function. Having become an entity in itself, it frequently happens that dissonance neither prepares nor anticipates anything ... The music of yesterday and today unhesitatingly unites parallel dissonant chords that thereby lose their functional value, and the ear quite naturally accepts their juxtaposition ... We thus no longer find ourselves in the framework of classical tonality in the scholastic sense of the word ...
>
> 'Having reached this point, it is no less indispensable ... to recognize the existence of certain poles of attraction. Diatonic tonality is only one means of orienting music toward

these poles. The function of tonality is completely subordinated to the force of attraction of the pole of sonority. All music is nothing more than a succession of impulses that converge toward a definite point of repose ... This general law of attraction is satisfied in only a limited way by the traditional diatonic system, for that system possesses no absolute value ...'

Schoenberg went still further than Stravinsky and abandoned tonality altogether. According to Rosen (1975:45–6), one source of stability for Schoenberg was the use of certain rhythmic features of tonal music without their underlying harmonic implications:

'Effects of dissonance and resolution arise here largely from the melodic lines and the phrasing implied by the rhythm' ... In fact, to the end of his life, Schoenberg wrote music whose rhythm and phrasing recalled the late Romantic style with which he had started. The rise and fall of his melodies imply the tonal oscillation from agitation to stability, and, although the strict sense of cadence, with its final absolute consonance, is not possible for Schoenberg, the feeling of cadence is re-created by the linear shape of each contrapuntal voice in his music.'

Rosen argues that, with the renunciation of the tonal center, almost the opposite principle emerged as a source of stability to Schoenberg and his disciples Berg and Webern—the filling-out of musical space with all the pitches of the chromatic scale: 'in tonality, the piling up of seconds creates tension; in Schoenberg's music after 1908, however, the filling-out of the chromatic space is clearly a movement toward stability and resolution' (p. 60). This concept of stability eventually led Schoenberg to the development of so-called 'twelve-tone' or 'serial' composition, in which all motivic and harmonic aspects of a work are constructed along certain principles from the work's tone row, a particular ordering of the twelve pitches of the chromatic scale. Serial principles gradually became increasingly influential, until even Stravinsky in his old age adopted them, while composers like Boulez and Babbitt experimented with serialization of rhythm, dynamics, and timbre along with that of pitch.

But perhaps no other musical development in history has come under such heavy and sustained attack. Works over sixty years old by Stravinsky, and particularly by Schoenberg, are still dismissed by many as 'crazy modern music'. Even a prestigious composer like Paul Hindemith, who himself wrote highly dissonant but nominally tonal music, delivered a bitter polemic against atonality in HIS Norton Lectures of 1949–50 (published 1961, pp. 64–5):

'Have we not heard many times of tendencies in modern music to avoid these tonal effects? It seems to me that attempts at avoiding them are as promising as attempts at avoiding the effects of gravitation ... And yet, some composers who have the ambition to eliminate tonality succeed to a certain degree in depriving the listener of the benefits of gravitation. To be sure they do not, contrary to their conviction, eliminate tonality; [but] harmonies both in vertical and horizontal form are arranged so that the tonics to which they refer change too rapidly. Thus we cannot adjust ourselves, cannot satisfy our desire for gravitational orientation.'

Note that Hindemith's argument is not the layman's reaction of 'I don't like it' or 'The music is too dissonant.' He is arguing rather that atonality goes against human nature, or perhaps even against nature itself, and that this fact explains its difficulty and lack of appeal.

B adopts the same line of argument, and at this point linguistics becomes relevant, since linguistic theory has been the first real success in putting some formal

substance into the notion of 'human nature' as it applies to a complex cognitive activity. The theory of a highly constrained innate linguistic ability makes a similarly constrained innate musical ability far more defensible than does a behavioristic attitude that the mind is infinitely plastic. Thus B can plausibly claim that 'the new musical "rules" of Schoenberg are not apparently based on innate awareness, on the intuition of tonal relationships. They are like rules of an artificial language, and therefore must be learned' (283) ... 'Is this perhaps why Schoenberg has still, to this day, not found his mass public—a large, concert-going public who loves his music?' (297). He suggests that the music of Schoenberg's colleague Berg has achieved its much greater success in the concert hall because of its re-introduction of tonal implications into serial music. In other words, tonal music appeals to something innate in us; atonal music does not, hence its lack of natural appeal.

Many contemporary composers reject this line of argument, since it apparently challenges the validity of their own work. They often reply that the real issue is simply one of exposure: if their music were played more often, people would get used to it and grow to love it. This is, of course, a special case of the behaviorist argument that anything can be learned through sufficient training. But, as Köhler 1927 and Chomsky 1976 point out, there are two different modes of learning: trial-and-error learning, which obeys the behaviorist's learning curve, and rapid learning on limited exposure, guided by innate ability. It is fairly clear that the assimilation of principles of simple tonal music, like the learning of language, lies in the latter domain, since nearly everyone learns to sing such music with some degree of skill. It is an empirical question, however, whether an arbitrary new way of organizing music can be so assimilated—or whether, like chess or quantum mechanics, its mastery is somewhere at the extreme limits of human ability, or even beyond them.

But this further step in the argument only provokes composers further. One well-known composer, discussing these issues with me, retorted angrily, 'It is NOT an empirical question; it is a political question!' The reason for his anger is that the innateness argument is often interpreted as though it implied an aesthetic judgment: the hidden premise is that if it does not appeal to innate capacities, it cannot be good art. B comes close to making such a judgment when he says that you can't LOVE serial music; so does Hindemith. But this premise is totally unjustified. We have no real psychological theory of why human beings have an aesthetic response, or of what they respond to. In the absence of such a theory, we can make no defensible claims about what constitutes good art. The strongest plausible argument that can be made is this: works of art whose perception utilizes pre-existing cognitive structure will be easier to comprehend than those whose perception requires principles of organization which must be learned with some difficulty. Insofar as this claim seems to have empirical consequences with respect to musical idioms, it suggests that tonality is a rather easily assimilated principle and serialism is not. But it has no consequences at all for the artistic value of works written in either idiom. Both idioms have produced acknowledged masterpieces; both have produced acknowledged trash.

3. THE ROLE OF THE OVERTONE SERIES IN TONALITY. With the question of aesthetic value thus laid to rest, we can return to the question of the innateness of tonality. Bernstein and Hindemith ask what it is in us that enables us to comprehend the

organization of tonal music; both pursue the same line of explanation, based on the structure of the overtone series. (The argument undoubtedly predates both of them, but I have been unable to locate its original source.) Although I agree that tonality reflects an innate organization of the pitch structure of music, I would like to show that the overtone series in fact has rather little to do with this ability.

Using B's and Hindemith's somewhat fragmentary accounts as a basis, we can piece together the following argument. We observe that, next to singing in unison with each other, people find it easiest to sing in octaves, often doing so without conscious effort. People sometimes even sing in fifths, thinking that they are singing in unison; this effect is, however, considerably weaker than that at the octave. Though B and Hindemith do not mention it, these results are not confined to humans. Apparently, if dogs are trained to respond to a particular pitch, and their responses are then tested on different pitches, a pitch an octave away from the original elicits much greater response than surrounding tones—and, to a lesser extent, the same is true of the fifth above the original tone.

To account for these results, it is observed that the octave and the fifth are intervals formed by the first two overtones of the harmonic series, as shown in Example 1.

EXAMPLE 1.

The theory is that we can consider two pitches similar—or that we find their combination less dissonant, more pleasing, or easier to sing—if one of them forms a unison with an overtone of the other, or if they are overtones of a common fundamental. Thus, goes the argument, the intervallic inventory of music has grown gradually more complex or sophisticated as people have come to perceive more overtones.

This hypothesis appears to account for certain developments in the history of Western music, since the next harmonic interval to appear after the fifth, during the late Middle Ages, was the fourth—the interval between the second and third overtones. After that, the major third began to appear—the interval between the third and fourth overtones. By sounding simultaneously the overtones up through the fourth, we arrive at the major triad, the fundamental building block of Western tonal music. By building a major triad on the second overtone, as well as on the fundamental, we get the opposition of dominant to tonic that is indispensable to classical harmony. Then we can add to the vocabulary the dominant of the dominant, the subdominant (whose second overtone is the original fundamental), etc.; and soon we have the complete system of Western tonality, all allegedly arising from consonances generated by the overtone series. So goes B's argument (35–7).

Closer examination shows that matters really aren't that simple. There was indeed an early period in the history of Western music in which the fourth was consonant and the third dissonant. But not too long after the introduction of the major third as a consonance, a fourth between the bass and another part came to be treated as dissonant, requiring resolution. This was its status in the classical period. Furthermore, there is no way to derive the minor triad from the overtone series. It is true that the minor triad is treated as somewhat less stable than the major, and was considered dissonant until the 17th century or so. But in the classical period it is a consonance. Since the fourth, generated by the overtone series, is dissonant, and the minor triad, not generated by the overtone series, is consonant, derivation from the overtone series is neither a sufficient nor a necessary condition for consonance, even in the musical idiom most familiar to us.

Another argument of B's (27–9) concerns the simplest version of the pentatonic scale—which, like the five-vowel system /i e a o u/, is widespread throughout the world:
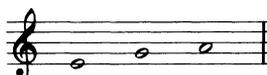
EXAMPLE 2.

B points out that this inventory of pitch relations is quite close to that provided by the first eight overtones (ignoring octave transpositions). Thus the overtone series, he claims, predicts this scale. The one minor discrepancy is the last note, *a*, which is to correspond to the sixth overtone of *c*, a flattened *b♭* (see Ex. 1). What is not explained is why, in so many cultures, the *a* is not the pure overtone but is much closer to the *a* of the diatonic scale, a fifth above *d*. To argue, as B does, that this is because the sixth overtone is 'in the cracks' of the natural scale, and the ear has difficulty hearing it, is in effect to abandon the hypothesis of the primacy of the overtone series, replacing it with some other unspecified principle.

A prediction follows from basing the pentatonic scale on the overtone series in this way: if an idiom has a smaller inventory of pitches, they should be selected from those below the eighth overtone. Thus the most highly favored system with only three distinct pitches should be the one in Example 3.
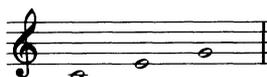
EXAMPLE 3.

B does not make this hypothesis explicitly in the Norton Lectures, but it appears in an earlier book (Bernstein 1959:187). It is not correct. Except in the idiom of bugle calls, something like Example 4 is much more likely, according to the survey of folk-music idioms by Nettl 1973.

EXAMPLE 4.

This might be described as the second, fourth, and sixth overtones of a hypothetical fundamental, as B observes in his discussion of the universal children's 'teasing chant' (27). But such an explanation weakens the principle upon which the pentatonic scale is supposedly based, namely using the lowest overtones first. Thus the hypothesis of the primacy of the overtone series not only is somewhat incorrect in its predictions about the simplest pentatonic scale, but is also seriously questionable with respect to tritonic scales.

Furthermore, the overtone series provides no direct account of versions of the pentatonic scale containing minor seconds, which B relegates to 'even more complex processes which we won't go into' (31). He gives the two cases of Example 5.

EXAMPLE 5.

Since the minor second appears in the overtone series only as the interval between the fourteenth and fifteenth overtones, one well might ask what happened to all the intervening intervals that are supposedly easier to hear.

To make things still worse, there are musical idioms in which the overtone series seems to play no significant role at all. Rouget & Schwarz 1970 describe a Sudanese idiom whose scale divides the octave into seven equal intervals, each slightly smaller than a whole step; thus no intervals other than the unison and the octave are present in the overtone series. The two-part music of the island of Krk in Yugoslavia (recorded on Lyrichord LL189) includes, besides the unison and the octave, only intervals completely foreign to Western ears, multiples of some interval smaller than the half step. Yet both of these idioms unmistakably have a tonal center.

Thus, beyond the octave and perhaps the fifth, it is difficult to make any very interesting connection between the overtone series and the universality of tonality. In a sense, this result is more significant than if B's explanation were correct, since it shows that tonality is not simply man's response to physical facts about sound. Rather, like language, tonality in music provides evidence for a cognitive organization with a logic all its own. The mind is not simply following the physical path of least resistance, as the overtone hypothesis would have it, but is creating its own way of organizing pitch combinations into coherent patterns.

4. MORE ABSTRACT MUSICAL STRUCTURE. As in linguistics, if the search for universals is to be anything but superficial, one must study much more thoroughly the structures which provide evidence for them. Because of the limited depth to which B restricts himself, he is in no position to investigate abstract universals of the sort to which linguists are accustomed. However, inspired in part by B's lectures, composer Fred Lerdahl and I have undertaken a program of research toward formalizing a theory of classical Western tonal music, with the intention of extracting musical universals. Our results to date are reported in some detail in Lerdahl & Jackendoff 1977; I will give here only the briefest of expositions, in order to suggest what kind of theory might begin to realize B's ambitions.

Recall that the goal of such a theory is to characterize an educated listener's musical intuitions. In formal terms, the theory must provide a set of 'structural descriptions', where the structural description of a piece is a formal representation of what the experienced listener hears in it. The task of a generative music theory for a given musical idiom is, then, to assign structural descriptions: if a piece is assigned no structural description, it is not within the idiom; if it has n structural descriptions, there are n distinct ways of hearing the piece within that idiom.

The structural descriptions at which we have arrived involve the contributions of four distinct components. Example 6 is a very brief illustration: the structural description assigned to the first four measures of the Mozart Sonata K. 331, describing the most plausible way of hearing them.

Here the metrical analysis expresses a hierarchy of strong and weak beats in regular patterns. Each dot in the analysis represents a beat, associated with the inception of the interval of time between it and the next dot on the same level. Each level of dots represents a level of metrical regularity; the dots on relatively larger levels of regularity are heard as relatively stronger beats. Thus the attack point of the first note of Ex. 6 is the strongest metrical point, since it is a beat at the four-measure metrical level; the attack point of the second note is a beat only at the sixteenth-note level, the weakest type of beat in the example.

The grouping analysis expresses the division of the piece into motives, groups, and phrases. The slurs under this example indicate the grouping. Each of the first two measures forms a group. But since, on the most plausible hearing, neither of the last two measures is independent, they form together a larger group. This larger group is in turn balanced by the group formed by the first two measures taken together, and the whole four-measure excerpt also forms a group which balances the next four measures of the piece.

So far there is nothing very startling about these analyses; however, in the paper cited above, we show that this particular formation of them leads to a more satisfactory analysis of rhythm than previous theories, such as those of Cooper & Meyer 1960 and Cone 1968. The parts of the structural description that are probably of more interest to linguists are the time-span and prolongational elaborations, since they somewhat resemble trees. However, they differ from linguistic trees in that they contain nothing analogous to syntactic categories, and they do not represent 'is-a' relations among categories (e.g. an NP followed by a VP *is an* S). Rather, the fundamental relationship they express is that of a sequence of notes (or chords) being AN

EXAMPLE 6.

ELABORATION OF a single note (or chord). Intuitively speaking, a sequence S can be said to be an elaboration of a single note N if N can be substituted for S without disturbing the musical sense of the passage of which S is a part. The note of which a sequence is an elaboration is always one of the notes in the sequence; the remaining notes in the sequence are heard as relatively ornamental. The time-span and prolongational elaborations in our theory describe the sense of a piece in terms of different principles of recursive elaboration; their interplay has a great deal to do with the sensations of tension and relaxation in one's hearing of a piece.

To illustrate how the trees represent successive elaboration, consider just the first three notes of the Mozart example above, and their time-span elaboration. The tree in Ex. 6 is a shorthand form of the process of elaboration indicated in Example 7 (overleaf).

The tree contains one branch for each note (or chord) of the piece. The longest branches in the tree represent the most fundamental points of articulation in the piece—essentially its beginning and final cadence—and the entire piece is an elaboration of these fundamental

Initial symbol   1st elaboration   2nd elaboration

EXAMPLE 7.

points. At each successive stage of elaboration, new notes are introduced; these form elabor-
ations of the notes already present, and branch from the notes which they elaborate. Under the
condition that branches cannot cross, later elaborations (representing structurally less essential
events in the piece) necessarily receive shorter branches in the tree.

The time-span elaboration represents the piece as elaborated successively from its beginning
and ending into the principal events of each major section, then into the principal events of
successively smaller levels of phrases and groups, and finally into the metrical units within each
group. This can be seen in Ex. 6, where the first note of the piece is attached to a higher level
of elaboration, not shown. The cadence closing the phrase is the next most important structural
event, and thus is attached to the tree with the next longest branch. This branch is in turn
elaborated into the rest of the second two-measure group. Meanwhile the beginning is elaborated
with a branch which develops into the second measure; finally the beginning sprouts a cluster
of branches which elaborate the first measure.

The prolongational elaboration represents melodic and harmonic continuity in the piece. In
this analysis, there are two types of elaboration: PROLONGATION, in which a single note or
chord is elaborated into two or more copies of itself; and CONTRAST, in which an inversion,
passing tone or chord, neighbor tone or chord, or appoggiatura is added as ornament. In
PROLONGATION, the event being elaborated is considered to be stretched out over time, neither
of its elaborations taking priority; such an elaboration is represented with a small circle at the
node. For example, the first and third notes of Ex. 6 form a prolongation of the root position
A-major chord; the circle represents this connection between them. In CONTRAST, the contrasting
element is treated as subsidiary to the original note or chord; this is represented by attaching
it with an ordinary branch. The second note of Ex. 6 is a neighbor note dissonant with the A-
major chord, and thus it is attached by a right branch to the preceding chord. All passing tones
and neighbor motions, which involve progress from the preceding event to the following one,
are represented as right branches; appoggiaturas, which involve delayed arrivals (e.g. the next-to-
last note in Ex. 6), are attached as left branches of the events they delay. The major harmonic
motion of the phrase, contained in its fourth measure, is attached with the longest branches.

Though the two types of elaboration to a great extent designate the same events as structurally
significant, particularly at larger levels, the connections they draw are often radically different.
Thus, in Ex. 6, the time-span elaboration makes no direct connection between the second and
third measures, since they are in disjoint groups; the prolongational elaboration, on the other
hand, connects them into a two-measure prolongation of the dominant harmony. Each tree
represents an important aspect of our musical intuition about this passage, and a theory which
did not include both trees in its structural descriptions would be incomplete. Thus the existence
of the two trees does not indicate that the passage is ambiguous. Both trees are part of a single
way of hearing the piece, i.e. part of a single structural description. Ambiguity arises only when
a piece can be assigned more than one complete structural description.

The rules used to assign structural descriptions fall into two types. WELL-FORMEDNESS RULES
are similar to phrase-structure rules in language, in that they define a class of structures. Each

of the four components of the structural description is defined by a fairly simple set of well-formedness rules. However, these rules alone generate a given piece in far too many ways, most of which wildly misrepresent the way in which the piece is heard. The selection of the correct structural description(s) is accomplished by a complex set of PREFERENCE RULES which assign relative degrees of 'coherence' or 'stability' to competing structural descriptions, taking fully into account the need for the components of the structural description to interact properly. The closest linguistic analog to the preference rules are rules of semantic interpretation, since both assign coherence to structural descriptions. But the analogy is not very enlightening: music, unlike language, has no referential function, so the notion of coherence in music must be defined in strictly syntactic terms.

Readers of LANGUAGE would no doubt be disappointed if our theory lacked transformations. Indeed, it seems to be necessary to define a highly constrained class of rules which map structural descriptions into other structural descriptions not generated by the well-formedness rules, i.e. a class of non-structure-preserving transformations. These are used to deal with situations such as elisions and overlaps—where the resolution of a progression, forming the end of a group, also functions as the beginning of another group. In the form generated by the well-formedness rules, such a progression appears twice, as the end of one group and as the beginning of the next; the transformation collapses the two identical events into one.

Our theory does not use two other conceivable types of transformations: rules that account for thematic and motivic relationships, and rules that relate irregular forms (such as five-measure phrases) to presumably archetypal, more regular forms (such as four-measure phrases). In each case, the variety of possible operations seems to lead to an extremely unconstrained notion of transformation, something which we wish to avoid. The first sort of relationship, we feel, must be embodied in a much more general theory of similarity such as is necessary, e.g., for recognizing facial similarities. The second sort of relationship is accounted for in the preference rules, which value most highly those analyses in which all the criteria for assigning structural descriptions reinforce each other; these turn out to be the simple, symmetrical, clearly articulated forms which are felt to be archetypal.

One of the most striking results that emerges from our analysis is that, through the operation of the preference rules, the choice of preferred time-span and prolongational elaborations is highly determined by the choice made in the metric and grouping analyses. In other words, the listener's understanding of the highly abstract aspects of the music is claimed to be largely a function of how he segments its surface. Thus our theory is a considerable improvement on Schenkerian analysis (described, e.g., in Salzer 1962), which closely resembles our prolongational elaboration in its conception: our theory distinguishes the structurally significant events formally from the grouping and metrical analyses, whereas Schenkerian analysis must rely on the analyst's intuition (or Procrustean bed) to pick out the structurally significant events.

This rich concept of musical structure suggests a great variety of candidates for musical universals. Those dealing with tonality concern primarily the well-formedness rules and preference rules for the two elaborations. Among these, perhaps the most important is the condition that a tonal piece must be elaborated, ultimately, from the prolongation of its tonic. What counts as a tonic (a single note, a chord etc.) and what counts as a permissible elaboration may vary, within limits, from culture to culture, but the notions of a central tonic and of successive elaboration seem to be essential.

It is interesting that the organization of serial music not only excludes the central tonic but seriously compromises the principle of elaboration at local levels. The principle of elaboration implies that the composer is in effect free to insert dissonant material of any length into a prolongation. On the other hand, the serial principle requires (at least in its simplest version) that the composer go through all twelve chromatic pitches before repeating; hence the lengths of possible elaborations are highly predetermined by the system.

Besides providing candidates for musical universals, this richer theory of musical structure permits a serious comparison with linguistic theory. The closest substantive parallels appear in the rules of the metrical component, which resemble the rules of poetic meters developed by Halle & Keyser 1971. Singer 1974 explicitly applies the Halle–Keyser model to Macedonian dance music, and her theory of metrical rules forms part of our metrical component.

On the other hand, the recursive structures of music are based on a principle of elaboration distinct from that in language; the interactions of the components are also of a nature entirely foreign to linguistic theory. I personally do not find this surprising, since music and language are, on the face of it, different facets of human cognitive activity. The results of this investigation thus help to differentiate cognitive activity into various 'mental organs' (in the sense of Chomsky 1976).

5. CONCLUSION. This review has dealt with only one aspect of B's book, tonality. At least as many interesting questions arise in connection with other themes that pervade the work—e.g., the relation of music and poetry through formal structure and through text-setting; musical affect and the relation of music and emotion; metaphor; and the nature of art itself. I have ignored these issues not because they lack intrinsic interest, but only because they have less direct connection with linguistic theory. My guess is that serious investigation of any of these areas would be equally rewarding, and would show that beneath his technical errors, B has rather profound intuitions about the nature of music. Though recovering these intuitions from the text is not always easy, and sometimes is quite frustrating, I consider the effort well worth it. *The unanswered question* is hardly a definitive statement on a new discipline, but B has given us an exciting challenge, and for that alone deserves serious attention.

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